

1

ELECTRO-OPTICAL DEVICE AND ELECTRONIC EQUIPMENT HAVING TOUCH PANEL WITH RESIN HAVING PARTICULAR ELASTIC MODULUS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to Japanese Patent Application No. 2006-017330, filed Jan. 26, 2006, the content of which are incorporated herein by reference.

BACKGROUND

1. Technical Field

This invention relates to an electro-optical device and to electronic equipment.

2. Related Art

In recent years, accompanying the diffusion of compact electronic information equipment such as the personal digital assistant (PDA) and palm-top computer, liquid crystal display devices in which touch panels are mounted as input devices on a liquid crystal display panel have come into wide use.

As an example of this touch panel, there is known to be an ultrasonic surface acoustic wave system provided with a glass substrate, a transmitter that generates surface acoustic waves on the surface of the glass substrate, and a receiver that detects the generated surface acoustic waves.

The surface acoustic waves that are propagated on the surface of the glass substrate are attenuated at the touched position when the user touches the surface of the glass substrate with a finger or the like. With touch panels of the ultrasonic surface acoustic wave system, the position touched by the user is detected using the properties pertaining to the attenuation of surface acoustic waves at the touched position.

With ordinary touch panels of the ultrasonic surface acoustic wave system, surface acoustic waves are generated on the outermost surface. Consequently, in the case where water droplets, oil droplets, dust or the like adhere to the outermost surface, the surface acoustic waves are attenuated. That is, with touch panels of the ultrasonic surface acoustic wave system, it is possible that the locations of adherence of water droplets, oil droplets, dust or the like will be mistakenly detected as positions that have been touched by the finger or the like of the user.

There is the problem that a touch panel device configured from one sheet of glass is weak in shock resistance, and particularly that it can be split by minor shocks if thinner glass is contrived.

Accordingly, a touch panel has been proposed that disposes transparent resin film or the like on the outermost surface of the glass substrate on which surface acoustic waves are propagated.

For example, Japanese Unexamined Patent Application, First Publication No. 2004-348686 discloses a touch panel provided with a glass substrate which propagates surface acoustic waves, transducers which transmit and receive surface acoustic waves and which are arranged so as to form a mutually opposing pair at the periphery of this glass substrate, a means for detecting the touch position of a physical object that makes contact within a prescribed operational area based on surface acoustic waves received by the transducers, and a transparent resin film which is arranged with interposition of a space layer relative to the glass substrate, and which has multiple dot spacers formed on the substrate-opposing face of the glass substrate.

2

In addition to transparent resin film, a transparent glass substrate or the like may also be used for protecting the outermost surface of the substrate which propagates the surface waves.

In such a touch panel configuration, the transparent substrate that propagates the surface acoustic waves is covered by the transparent resin film, and is not exposed. Consequently, malfunctions due to flaws, water droplets and other contamination are prevented, and shattering due to splintering of the glass substrate is prevented.

In the aforementioned patent literature, the outer face of the transparent resin film is the input face that the user presses. At the time of input, the specified position of the outer face of the transparent resin film is pressed, and the transparent resin film bends. The bent part of the transparent resin film contacts the surface of the glass substrate, causing attenuation of the surface acoustic waves that are propagated on the glass substrate surface. The transducers detect the position pressed by the user based on the attenuation factor of these surface acoustic waves.

However, the elastic modulus (Young's modulus) of the transparent resin film (glass substrate) is comparatively high. When the transparent resin film does not adequately bend in response to user pressure, it is not possible to cause attenuation of the surface acoustic waves that are propagated on the surface of the glass substrate. In such a case, there is the problem that the position pressed by the user cannot be accurately detected, and input malfunctions occur.

SUMMARY

An advantage of some aspects of the invention is to provide an electro-optical device and electronic equipment which accurately detect the position at which the user imparts pressure, and which prevent input malfunctions.

An electro-optical device according to a first aspect of the invention includes: an electro-optical panel having a first substrate, a second substrate, and an electro-optical substance interposed between the first and the second substrates; a third substrate arranged on the second substrate; a fourth substrate having a flexibility and arranged on the third substrate via a spacer; a position detector provided on the third substrate and detecting a pressed position on the fourth substrate based on changes in surface waves generated on the third substrate; and a resin film provided on the fourth substrate and opposed to the third substrate.

According to the first aspect, the third substrate, the fourth substrate, the position detector and the resin film constitute a touch panel of the so-called ultrasonic wave system. The touch panel of the ultrasonic wave system generates surface waves on the substrate by sound waves which are ultrasonic waves or the like, and detects the position at which pressing by an object of input occurs by the position detector based on changes in the surface waves. The surface waves are waves that are propagated without emitting energy along the boundary between two different mediums. As the aforementioned object of input, one may cite a finger, touch pen or the like of the operator conducting the input.

In this electro-optical device, the outer face side of the flexible fourth substrate (the face opposite the third substrate side) is the input face which is pressed by the user. By imparting pressure to the input face of the fourth substrate, the resin film and the fourth substrate bend toward the third substrate. The bent part of the resin film contacts the third substrate. The contact area of the third substrate and the bent portion of the resin film is expanded by having the resin film absorb the stress due to the application of pressure. The surface waves